AN INTEGRATED ENERGY SYSTEM TECHNO-ECONOMIC ASSESSMENT FOR NON-INTERCONNECTED ISLANDS: THE CASE OF AMORGOS ISLAND, GREECE

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ABSTRACT

This study aims to design a power generation system using 100% Renewable Energy Sources (RES) and Green Hydrogen to cover the energy needs of an off-grid island in the Aegean Sea, and particularly Amorgos Island. The primary electricity generation alternates between wind and solar energy to optimize energy efficiency, while the state-of-the-art technology is energy storage in the form of green hydrogen. Green hydrogen is produced from water electrolysis utilizing the energy excess [1] (Power-to-H_2), while it is consumed and converted to electricity (H_2-to-Power) when there is renewable energy shortage. Two scenarios are examined for H_2-to-Power, namely Combustion through Gas Turbines and Utilization of Fuel Cells. The overall production and use of Hydrogen, as a rechargeable battery, overcomes the intermittent and weather-dependent RES electricity generation, by providing adequate power supply to the island via indigenous resources, and achieves zero direct greenhouse gas emissions. Both technical and economic aspects of the investment have been studied. The technical analysis, which has been carried out, includes the island's energy demand based on historical data [2] and the energy balance settlement for the calculation of significant parameters for each unit of the system. The Levelized Cost of Hydrogen production (LCOH) and the Levelized Cost of total Electricity generation (LCOE) are analyzed and compared to the existing diesel-based electricity generation system of the island and to similar sustainable projects in the relevant technical literature [3]. Regarding financial attractiveness, this particular investment is assessed as marginally profitable with very optimistic results. The findings of this research contribute valuable insights into the development of sustainable energy solutions for non-interconnected islands, paving the way for environmentally friendly and resilient power systems in remote regions. The successful integration of photovoltaic panels, wind energy, and hydrogen storage, presented in this study, indicates a viable model for other isolated communities striving to achieve energy independence and reduce their carbon footprint.

KEYWORDS: Power-to-H_2-to-Power, Green Hydrogen, Non-Interconnected Islands

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